EXHIBIT 166
REDACTED

Reviewers

▮▮▮▮ nirmaljayaram@, ▮▮▮▮ nitish@, ▮▮▮▮

TBD : ▮▮▮▮ ▮▮▮▮ ▮▮▮▮ ▮▮▮▮ ▮▮▮▮

Box 1: Introduction

The gTrade team in display ads is responsible for connecting different Google's advertising platforms, namely, Google Display Ads (GDA fka GDN) and Display & Video 360 (DV360 fka DBM) to ad exchanges both Google Owned & Operated (O&O) such as AdMob and AdX and Third Party Exchanges (3PEs) such as Rubicon, Casale Media etc. Publishers partner with ad exchanges to monetize their inventory.

Exchanges use different auction mechanisms to sell their inventory. While AdX and AdMob run 2nd Price (2P) auctions it is typical for 3PEs to use a variety of auction types. Different auction types require different bidding strategies. For example 2P auctions are incentive compatible since the winner is charged the runner up bid. So buyers can bid their true value without worrying about overpaying. Exchanges see the gap between winning and runner up bids and are tempted to close the gap to increase their yield. Many 3PEs run 1st Price (1P) auctions on some portion of their inventory where the winner is charged their bid. In such actions, buyers should shade their bids (bid < value). The amount of bid shading depends on the competition. For example a clairvoyant bidder would bid 1 cent above the runner up.

▮▮▮▮▮▮▮▮

To add to the complexity many exchanges are untruthful about their auction type since the actual auction used is opaque to buyers. They claim be running 2P auctions hoping that buyers don't shade their bids and charge the winner something between the runner up and winning bid. We call these auctions untruthful 2P auctions. Truthful 2P auctions are a rarity on 3PEs.

Any auction where the clearing price (cost) depends on winning bid is not incentive compatible and needs bid shading. I am the Tech Lead for a team of 3 data scientists and 4 SWEs focused on efficiently bidding in such auctions. I work closely with several teams such as AdX Quality, DV360 Infra, DV360 Opt, and GDA Opt.

Box 2. Project Poirot: Bidding into adversarial auctions on 3PEs

Fixed CPM advertisers in DV360 (▮▮ ARR) specify one CPM bid in the frontend even though they buy across multiple exchanges. If all exchanges ran truthful 2P auctions then bidding for such advertisers would be trivial. In reality, bidding is complicated since truthful 2P auction is a rarity on 3PEs. Exchanges different in auction mechanisms and competitive landscape.

Poirot was created to help advertisers manage the nuances of bidding on different exchanges. The objective is to maximize advertiser surplus (value - cost). It is based on the explore and exploit methodology. ▮▮▮▮▮▮▮▮

▮▮▮▮▮▮▮▮

▮▮▮▮ Before I joined gTrade team the initial version of Poriot ▮▮▮▮) was launched on an accelerated timeline. The model for surplus was basic and hard to interpret. I led a

concerted effort to improve performance of Poirot with significant improvements in surplus modeling which lead to better fits, interpretability, and robustness.

Key contributions:
- Proposed ████████████ and launched ariane/215784 summary doc a new model for surplus that improved both the interpretability and model fit (lowers residual variance by ████) without increasing model complexity.
- Proposed metrics for Poirot and ████████████████████████████
  ██
  ██
  ████████████████████████
- 2018 saw 3PEs declaring the auction type on a sizable chunk of their inventory as 1P. I mentored and led ████ to add action type as feature to Poirot ariane/259738 summary doc. Adding auction type in Poirot was highly non trivial ████████████
  ██
  ██
  ██
  ██
  ██
  ████████████████████████
- I worked with DV360 eng, PMs, sales, and PR to communicate the impact on Poirot launches to advertisers. I led ████ to document the efficacy of Poirot in protecting advertisers (████████████████████████████████████t). Poirot saves advertisers $████ annually.
- Poirot for AwBid: AwBid (████████) refers to the GDA traffic that bids on 3PEs ████████. I proposed (████████████) and led ████ to design (████████████████) and launch ariane/258064.

Impact:
Changes to Poirot resulted in ████ increase in advertiser surplus across all 3PEs saving them an estimated ████ annually. The spend on 3PEs dropped by ████████████. Due to DV360 advertisers being mostly budget constrained this resulted in a mix shift in spend across exchanges in favour of exchanges running truthful 2P auctions such as AdX increasing Google Profit by ████ ████████). Poirot for AwBid increased advertiser ROI on 3PE slice by ████.

Box 3. AdX 1st Price Bidder
AdX and AdMob have been running 2P auctions since inception. While 2P auctions were supposed to simplify buying publishers have been finding ways to game it. For example on apps publishers engage in multi-calls where they call AdX/AdMob multiple times with decreasing floors to fish out the highest bid. Web publishers on the other hand have started using header bidding which allows them to pit AdX against 3PEs in a 1P auction. This put AdX at a huge disadvantage since the clearing price from its 2P auction i.e., AdX runner up bid is compared to the 1P bids from 3PEs. So AdX could lose to a 3PE bid even if AdX highest bid was actually higher. To remove this disadvantage "last look" was implemented which allowed AdX to look at the highest 3PE bid

and beat it by 1¢. This was widely perceived in the industry as unfair. To clean up and simplify the sell-side ecosystem AdX and AdMob decided to move to "transparent" 1P (T1P) auction and depreciate last look in Sept 2019.

For Google buyers this has huge ramifications as it impacts ███████████ of their total spend. Unlike in 2P auctions, bidding in 1P is complex as I will explain below. On top of this giving up last look alone leads to revenue losses of ███████████ for GDA and DV360 respectively. So we have a lot of ground to make up here.

I led the effort to design, develop and launch (ariane/311348 ████████████████████████) bidders for DV360 and GDA with a team of 3 data scientists and 4 SWEs in a span of 4 quarters. A total of ████ ARR flows through these bidders. This was a big cross-team effort involving close coordination with DRX quality, DV360 Serving, GDA Opt, and DBM Opt teams. I set the agenda for multiple quarters and drove weekly syncs both within our team and across teams. As we got closer to the launch I ran daily scrum (notes) to identify and resolve issues quickly.

Key contributions:

███
███
███
███
███
███
███████████████████████████

Common framework:

- ███
  ███
  ███
  ███
  ███
  ███
  ███
  ███
- ███
  ███
  ███
  ███
  ████
  - Training data: AdX started reporting HOB recently and this data is not yet available in FLOGS (████████). I created lingo based data collection pipelines for DV360 (████████ design doc) and GDA (████████████).